

IN THE CLAIMS

Please amend claims 1 and 40 as indicated.

1. (Presently Amended) A semiconductor wafer cleaning formulation, comprising between about 1% and about 21% fluoride source, between about 20% and about 55% organic amine, between about 0.5% and about 40% carboxylic acids and imines, between about 23% and about 50% water, and a metal chelating agent. ~~the following components in the percentage by weight ranges shown, based on the total weight of such components:~~

fluoride source	1-21%
organic amine(s)	20-55%
a nitrogenous component, selected from nitrogen-containing	
carboxylic acids and imines	0.5-40%
water	23-50%
<u>metal chelating agent(s)</u>	<u>0-21%</u>
TOTAL	100%

2. (Original) The cleaning formulation of claim 1 wherein said fluoride source comprises a fluoride species selected from the group consisting of:
ammonium fluoride; and
triethanolammonium fluoride (TEAF).

3. (Original) The cleaning formulation of claim 1 wherein said organic amine(s) comprise an amine selected from the group consisting of:

diglycolamine (DGA);

methyldiethanolamine (MDEA),

pentamethyldiethylenetriamine (PMDETA),

triethanolamine (TEA), and

triethylenediamine (TEDA).

4. (Original) The cleaning formulation of claim 1 wherein said nitrogenous component comprises a species selected from the group consisting of:

iminodiacetic acid (IDA);

glycine;

nitrilotriacetic acid (NTA); and

1,1,3,3-tetramethylguanidine (TMG).

5. (Original) The cleaning formulation of claim 1 including at least one metal chelating agent selected from the group consisting of:

acetoacetamide,

ammonium carbamate,

ammonium pyrrolidinedithiocarbamate (APDC),

dimethyl malonate,

methyl acetoacetate,

N-methyl acetoacetamide,
2,4-pentanedione,
tetramethylammonium thiobenzoate,
tetramethylammonium trifluoroacetate, and
tetramethylthiuram disulfide (TMTDS).

6. (Original) The cleaning formulation of claim 1 wherein said fluoride source comprises a species selected from the group consisting of:

ammonium fluoride,
triethanolammonium fluoride (TEAF),
diglycolammonium fluoride (DGAF),
tetramethylammonium fluoride (TMAF), and
triethylamine tris (hydrogen fluoride) (TREAT-HF).

7. (Original) The cleaning formulation of claim 1 wherein said organic amine(s) comprises an amine selected from the group consisting of:

diglycolamine (DGA),
methyldiethanolamine (MDEA),
pentamethyldiethylenetriamine (PMDETA),
triethanolamine (TEA),
triethylenediamine (TEDA),
hexamethylenetetramine,
3, 3-iminobis (N,N-dimethylpropylamine), and

monoethanolamine.

8. (Original) The cleaning formulation of claim 1, wherein said nitrogenous component comprises a species from the group consisting of:

iminodiacetic acid (IDA)

glycine

nitrilotriacetic acid (NTA)

1,1,3,-tetramethylguanidine (TMG)

$\text{CH}_3\text{C}(=\text{NCH}_2\text{CH}_2\text{OH})\text{CH}_2\text{C}(\text{O})\text{N}(\text{CH}_3)_2$

$\text{CH}_3\text{C}(=\text{NCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OH})\text{CH}_2\text{C}(\text{O})\text{N}(\text{CH}_3)_2$

$\text{CH}_3\text{C}(=\text{NH})\text{CH}_2\text{C}(\text{O})\text{CH}_3$

$(\text{CH}_3\text{CH}_2)_2\text{NC}(=\text{NH})\text{N}(\text{CH}_3\text{CH}_2)_2$

$\text{HOOCCH}_2\text{N}(\text{CH}_3)_2$

$\text{HOOCCH}_2\text{N}(\text{CH}_3)\text{CH}_2\text{COOH}$

9. (Original) The cleaning formulation of claim 1 wherein said fluoride source comprises a species selected from the group consisting of:

Ammonium fluoride,

triethanolammonium fluoride (TEAF),

diglycolammonium fluoride (DGAF),

tetramethylammonium fluoride (TMAF), and

triethylamine tris (hydrogen fluoride) (TREAT-HF);

said organic amine(s) comprise a species selected from the group consisting of:

diglycolamine (DGA),
methyldiethanolamine (MDEA),
pentamethyldiethylenetriamine (PMDETA),
triethanolamine (TEA),
triethylenediamine (TEDA),
hexamethylenetetramine,
3, 3-iminobis (N,N-dimethylpropylamine), and
monoethanolamine;

said nitrogenous component comprises a species selected from the group consisting of:

iminodiacetic acid (IDA)
glycine
nitrilotriacetic acid (NTA)
1,1,3,3-tetramethylguanidine (TMG)

and said formulation includes a metal chelating agent comprising a species selected from the group consisting of:

acetoacetamide,
ammonium carbamate,
ammonium pyrrolidinedithiocarbamate (APDC),
dimethyl malonate,
methyl acetoacetate,
N-methyl acetoacetamide,
2,4-pentanedione,
tetramethylammonium thiobenzoate,

tetramethylammonium trifluoroacetate, and
tetramethylthiuram disulfide (TMTDS).

10. (Original) The cleaning formulation of claim 1 wherein said fluoride source comprises a compound having the general formula $R_1R_2R_3R_4NF$ in which each of the R groups is independently selected from hydrogen atoms and aliphatic groups, and wherein said formulation includes a metal chelating agent of the formula:

X-CHR-Y, in which

R is either hydrogen or an aliphatic group and

X and Y are functional groups containing multiply bonded moieties having electron-withdrawing properties.

11. (Original) The cleaning formulation of claim 10 wherein each of X and Y is independently selected from $CONH_2$, $CONHR'$, CN, NO_2 , SOR' , and SO_2Z in which R' is alkyl and Z is hydrogen, halo, or alkyl.

12. (Original) The cleaning formulation of claim 1 wherein said fluoride source comprises a compound having the formula $R_1R_2R_3R_4NF$ in which each of the R groups is hydrogen or aliphatic, and wherein said formulation includes a metal chelating agent of the formula, $R_1R_2R_3R_4N^+O_2CCF_3$ in which each of the R groups is independently hydrogen or aliphatic.

13. (Original) The cleaning formulation of claim 1, wherein said nitrogenous component includes a compound having the formula:



wherein each of R and R' is independently selected from the group consisting of hydrogen, alkyl, aryl, and carboxylic acids.

14. (Original) A method for fabricating a semiconductor wafer, comprising:

plasma etching a metalized layer from a surface of the wafer;

plasma ashing a resist from the surface of the wafer;

cleaning the wafer by contacting same with a cleaning formulation, comprising the following components in the percentage by weight ranges shown, based on the total weight of such components:

fluoride source	1-21%
organic amine(s)	20-55%
a nitrogenous component, selected from nitrogen-containing	
carboxylic acids and imines	0.5-40%
water	23-50%
<u>metal chelating agent(s)</u>	<u>0-21%</u>
TOTAL	100%

15. (Original) The method of claim 14 wherein said fluoride source comprises a fluoride species selected from the group consisting of:

ammonium fluoride; and

triethanolammonium fluoride (TEAF).

16. (Original) The method of claim 14 wherein said organic amine(s) comprise an amine selected from the group consisting of:

diglycolamine (DGA),

methyldiethanolamine (MDEA),

pentamethyldiethylenetriamine (PMDETA),

triethanolamine (TEA), and

triethylenediamine (TEDA).

17. (Original) The method of claim 14 wherein said nitrogenous component comprises a species selected from the group consisting of:

iminodiacetic acid (IDA);

glycine;

nitrilotriacetic acid (NTA); and

1,1,3,3-tetramethylguanidine (TMG).

18. (Original) The method of claim 14 including at least one metal chelating agent selected from the group consisting of:

acetoacetamide,

ammonium carbamate,

ammonium pyrrolidinedithiocarbamate (APDC),

dimethyl malonate,
methyl acetoacetate,
N-methyl acetoacetamide,
2,4-pentanedione,
tetramethylammonium thiobenzoate,
tetramethylammonium trifluoroacetate, and
tetramethylthiuram disulfide (TMTDS).

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19. (Original) The method of claim 14 wherein said fluoride source comprises a species selected from the group consisting of:

ammonium fluoride,
triethanolammonium fluoride (TEAF),
diglycolammonium fluoride (DGAF),
tetramethylammonium fluoride (TMAF), and
triethylamine tris (hydrogen fluoride) (TREAT-HF).

20. (Original) The method of claim 14 wherein said organic amine(s) comprises an amine selected from the group consisting of:

diglycolamine (DGA),
methyldiethanolamine (MDEA),
pentamethyldiethylenetriamine (PMDETA),
triethanolamine (TEA),
triethylenediamine (TEDA),

hexamethylenetetramine,

3, 3-iminobis (N,N-dimethylpropylamine), and

monoethanolamine.

21. (Original) The method of claim 14, wherein said nitrogenous component comprises a species from the group consisting of:

iminodiacetic acid (IDA)

glycine

nitrilotriacetic acid (NTA)

1,1,3,-tetramethylguanidine (TMG)

$\text{CH}_3\text{C}(=\text{NCH}_2\text{CH}_2\text{OH})\text{CH}_2\text{C}(\text{O})\text{N}(\text{CH}_3)_2$

$\text{CH}_3\text{C}(=\text{NCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OH})\text{CH}_2\text{C}(\text{O})\text{N}(\text{CH}_3)_2$

$\text{CH}_3\text{C}(=\text{NH})\text{CH}_2\text{C}(\text{O})\text{CH}_3$

$(\text{CH}_3\text{CH}_2)_2\text{NC}(=\text{NH})\text{N}(\text{CH}_3\text{CH}_2)_2$

$\text{HOOCCH}_2\text{N}(\text{CH}_3)_2$

$\text{HOOCCH}_2\text{N}(\text{CH}_3)\text{CH}_2\text{COOH}$

22. (Original) The method of claim 14 wherein said fluoride source comprises a species selected from the group consisting of:

ammonium fluoride,

triethanolammonium fluoride (TEAF),

diglycolammonium fluoride (DGAF),

tetramethylammonium fluoride (TMAF), and

triethylamine tris (hydrogen fluoride) (TREAT-HF);

said organic amine(s) comprise a species selected from the group consisting of:

diglycolamine (DGA),

methyldiethanolamine (MDEA),

pentamethyldiethylenetriamine (PMDETA),

triethanolamine (TEA),

triethylenediamine (TEDA),

hexamethylenetetramine,

3, 3-iminobis (N,N-dimethylpropylamine), and

monoethanolamine;

said nitrogenous component comprises a species selected from the group consisting of:

iminodiacetic acid (IDA)

glycine

nitrilotriacetic acid (NTA)

1,1,3,3-tetramethylguanidine (TMG)

and said formulation includes a metal chelating agent comprising a species selected from the group consisting of:

acetoacetamide,

ammonium carbamate,

ammonium pyrrolidinedithiocarbamate (APDC),

dimethyl malonate,

methyl acetoacetate,

N-methyl acetoacetamide,
2,4-pentanedione,
tetramethylammonium thiobenzoate,
tetramethylammonium trifluoroacetate, and
tetramethylthiuram disulfide (TMTDS).

23. (Original) The method of claim 14 wherein said fluoride source comprises a compound having the general formula $R_1R_2R_3R_4NF$ in which each of the R groups is independently selected from hydrogen atoms and aliphatic groups, and wherein said formulation includes a metal chelating agent of the formula:

X-CHR-Y, in which

R is either hydrogen or an aliphatic group and

X and Y are functional groups containing multiply bonded moieties having electron-withdrawing properties.

24. (Original) The method of claim 23 wherein each of X and Y is independently selected from $CONH_2$, $CONHR'$, CN , NO_2 , SOR' , and SO_2Z in which R' is alkyl and Z is hydrogen, halo, or alkyl.

25. (Original) The method of claim 14 wherein said fluoride source comprises a compound having the formula $R_1R_2R_3R_4NF$ in which each of the R groups is hydrogen or aliphatic, and wherein said formulation includes a metal chelating agent of the formula, $R_1R_2R_3R_4N^+ - O_2CCF_3$ in which each of the R groups is independently hydrogen or aliphatic.

26. (Original) The method of claim 14, wherein said nitrogenous component includes a compound having the formula:



wherein each of R and R' is independently selected from the group consisting of hydrogen, alkyl, aryl, and carboxylic acids.

27. (Original) A method for fabricating a semiconductor wafer including the steps comprising:

plasma etching a metalized layer from a surface of the wafer;

plasma ashing a resist from the surface of the wafer;

cleaning the wafer by contacting same with a cleaning formulation, comprising the following components in the percentage by weight ranges shown, based on the total weight of such components:

a fluoride source;	1-21%
at least one organic amine;	20-55%
a nitrogen-containing carboxylic acid or imine	0.5-40%
water;	23-50%
<u>at least one metal chelating agent</u>	<u>0-21%</u>
TOTAL	100%

28. (Original) The method of claim 27 wherein said fluoride source is chosen from the group consisting of:

ammonium fluoride; and

triethanolammonium fluoride (TEAF).

29. (Original) The method of claim 27 wherein said organic amine is chose from the group consisting of:

diglycolamine (DGA),

methyldiethanolamine (MDEA),

pentamethyldiethylenetriamine (PMDETA),

triethanolamine (TEA), and

triethylenediamine (TEDA).

30. (Original) The method of claim 27 wherein said nitrogen-containing carboxylic acid or imine is selected from the group consisting of:

iminodiacetic acid (IDA)

glycine

nitrilotriacetic acid (NTA)

1,1,3,3-tetramethylguanidine (TMG)

31. (Original) The method of claim 27 wherein said metal chelating agent is selected from the group consisting of:

acetoacetamide,

ammonium carbamate,

ammonium pyrrolidinedithiocarbamate (APDC),
dimethyl malonate,
methyl acetoacetate,
N-methyl acetoacetamide,
2,4-pentanedione,
tetramethylammonium thiobenzoate,
tetramethylammonium trifluoroacetate, and
tetramethylthiuram disulfide (TMTDS).

32. (Original) The method of claim 27 wherein said fluoride source is selected from the group consisting of:

ammonium fluoride,
triethanolammonium fluoride (TEAF),
diglycolammonium fluoride (DGAF),
tetramethylammonium fluoride (TMAF), and
triethylamine tris (hydrogen fluoride) (TREAT-HF).

33. (Original) The method of claim 27 wherein said organic amine is selected from the group consisting of:

diglycolamine (DGA),
methyldiethanolamine (MDEA),
pentamethyldiethylenetriamine (PMDETA),
triethanolamine (TEA),

triethylenediamine (TEDA),
hexamethylenetetramine,
3, 3-iminobis (N,N-dimethylpropylamine), and
monoethanolamine.

34. (Original) The method of claim 27, wherein said nitrogen-containing carboxyl acid or imine is selected from the group consisting of:

iminodiacetic acid (IDA)

glycine

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nitrilotriacetic acid (NTA)

1,1,3,-tetramethylguanidine (TMG)

$\text{CH}_3\text{C}(=\text{NCH}_2\text{CH}_2\text{OH})\text{CH}_2\text{C}(\text{O})\text{N}(\text{CH}_3)_2$

$\text{CH}_3\text{C}(=\text{NCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OH})\text{CH}_2\text{C}(\text{O})\text{N}(\text{CH}_3)_2$

$\text{CH}_3\text{C}(=\text{NH})\text{CH}_2\text{C}(\text{O})\text{CH}_3$

$(\text{CH}_3\text{CH}_2)_2\text{NC}(=\text{NH})\text{N}(\text{CH}_3\text{CH}_2)_2$

$\text{HOOCCH}_2\text{N}(\text{CH}_3)_2$

$\text{HOOCCH}_2\text{N}(\text{CH}_3)\text{CH}_2\text{COOH}$

35. (Original) The method of claim 27 wherein said fluoride source is selected from the group consisting of:

ammonium fluoride,

triethanolammonium fluoride (TEAF),

diglycolammonium fluoride (DGAF),
tetramethylammonium fluoride (TMAF), and
triethylamine tris (hydrogen fluoride) (TREAT-HF);

said organic amine is chosen from the group consisting of:

diglycolamine (DGA),
methyldiethanolamine (MDEA),
pentamethyldiethylenetriamine (PMDETA),
triethanolamine (TEA),
triethylenediamine (TEDA),
hexamethylenetetramine,
3, 3-iminobis (N,N-dimethylpropylamine), and
monoethanolamine;

said nitrogen-containing carboxylic acid or imine is chosen from the group consisting of:

iminodiacetic acid (IDA)
glycine
nitrilotriacetic acid (NTA)
1,1,3,3-tetramethylguanidine (TMG)

and said metal chelating agent is selected from the group consisting of:

acetoacetamide,
ammonium carbamate,
ammonium pyrrolidinedithiocarbamate (APDC),
dimethyl malonate,
methyl acetoacetate,

N-methyl acetoacetamide,
2,4-pentanedione,
tetramethylammonium thiobenzoate,
tetramethylammonium trifluoroacetate, and
tetramethylthiuram disulfide (TMTDS).

36. (Original) The method of claim 27 wherein said fluoride source comprises a compound having the formula $R_1R_2R_3R_4NF$ in which each of the R groups is hydrogen atoms or aliphatic, and wherein said metal chelating agent has the formula:

X-CHR-Y, in which

R is either hydrogen or an aliphatic group, and

X and Y are functional groups containing multiply-bonded moieties having electron-withdrawing properties.

37. (Original) The method of claim 27 wherein said fluoride source comprises a compound having the formula $R_1R_2R_3R_4NF$ in which each of the R groups is hydrogen or aliphatic, and wherein said metal chelating agent has the formula, $R_1R_2R_3R_4N^+ \cdot O_2CCF_3$ in which each of the R groups is hydrogen or aliphatic.

38. (Original) The method of claim 27, wherein said nitrogen-containing carboxylic acid has the formula:



wherein each of R and R' is independently selected from the group consisting of hydrogen, alkyl, aryl, and carboxylic acid.

39. (Original) A method of removing residue from a wafer following a resist plasma ashing step on said wafer, comprising contacting the wafer with a cleaning formulation, including (i) a fluoride source, (ii) at least one organic amine, (iii) a nitrogen-containing carboxylic acid or an imine, (iv) water, and optionally at least one metal chelating agent.

40. (Presently Amended) A wafer cleaning formulation, including (i) a fluoride source, (ii) at least one organic amine, (iii) a nitrogen-containing carboxylic acid or an imine, (iv) water, and ~~optionally at least one~~ a metal chelating agent.
